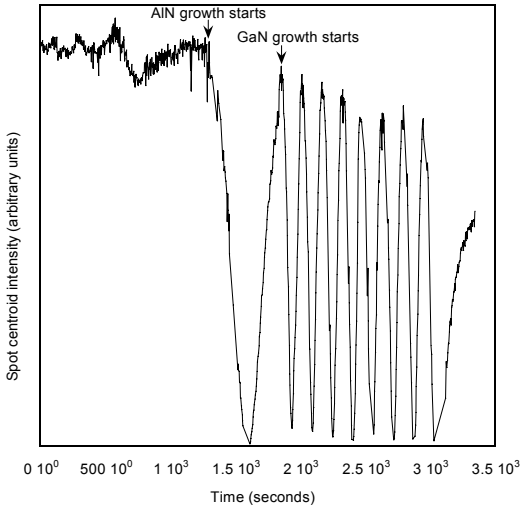
Acquisition of an MOVPE System for Electronic Materials Research and Education

Joan M. Redwing – Penn State University (DMR #0076312)

Research Accomplishments

Metalorganic Vapor Phase Epitaxy (MOVPE) System

A system for the metalorganic vapor phase epitaxy of (Al,Ga,In)N alloys was constructed to enable a combination of fundamental studies of transport, growth chemistry, nucleation and thin film stress evolution. The system includes an optical stress measurement system to provide real time information on sample curvature and thin film growth rate in order to study the evolution and magnitude of thin film stress during growth. The MOVPE system is currently being used to study stress evolution in GaN growth on Si substrates, InN growth as well as the fabrication of UV-emitting structures.



Laser Intensity Oscillations in AlN/GaN Growth on (111)Si

MOVPE Reactor with Stress Measurement System

***In-situ* Growth Rate and Stress Measurements**

The multi-beam optical stress measurement technique utilizes a linear array of parallel laser beams and a high resolution CCD camera to provide information on sample curvature and stress as a function of time. Oscillations in the reflected laser intensity as a function of time are used to provide information on the growth rate of the thin film in real time.

Acquisition of an MOVPE System for Electronic Materials Research and Education

Joan M. Redwing – Penn State University (DMR #0076312)

Education and Outreach Highlights

Industrial Collaboration

Penn State is collaborating with Air Products and Chemicals, Inc. to evaluate and develop high purity ammonia gas sources for (Al,Ga,In)N thin film deposition. The MOVPE system is used to deposit thin films of GaN and AlGaN using ammonia sources supplied by Air Products. Secondary ion mass spectroscopy is used to measure impurity levels in the thin films in order to understand the impact of impurities on the structural, electrical and optical properties of the material.

Graduate Education

The MOVPE system is the central piece of experimental equipment in use by a postdoctoral researcher and three graduate students who are pursuing Ph.D. degrees in Materials Science and Engineering.

Undergraduate Education

Metalorganic vapor phase epitaxy is included as a course topic in a senior level undergraduate course entitled “Synthesis and Processing of Electronic and Photonic Materials” that is offered in the Department of Materials Science and Engineering at Penn State. As part of this course, students have the opportunity to tour the MOVPE lab and see firsthand how the equipment is designed and used for thin film deposition.